

Claims

[c1] A method of extruding a polymeric foam from an extrudate comprising a polymeric resin and a blowing agent for providing the polymeric resin with a cellular structure upon exiting from an extruder having an annular die with an annular die opening and a choke ring having a choke ring aperture formed by an annular choke ring surface and sized to receive at least a portion of the annular die, the annular die defining a longitudinal axis from which the annular die opening is spaced a first radial distance and the annular choke ring surface is spaced a second radial distance, the method comprising:
forming the extrudate by mixing a polymeric resin and a blowing agent; and
extruding the extrudate through the annular die opening so that the extrudate leaving the annular die opening contacts the annular choke ring surface within a contact time of 1.0 to 20.0 milliseconds (ms).

[c2] The method of claim 1 and further comprising the step of constraining the extruded foam in contact with the choke ring for a constraint time of 5 to 75 ms.

[c3] The method of claim 2 wherein the constraint time is 8 to 50 milliseconds.

[c4] The method of claim 1 wherein the blowing agent is substantially 100% carbon dioxide.

[c5] The method of claim 2 wherein the blowing agent is a blend comprising carbon dioxide.

[c6] The method of claim 5 wherein the blend comprises carbon dioxide and pentane.

[c7] The method of claim 6 wherein the blend comprises less than 50% pentane.

[c8] The method of claim 1 wherein the extrudate is pulled away from the die at a line speed of 50 mm/s to 250 mm/s.

[c9] The method of claim 1 wherein the polymeric resin is a styrenic resin.

[c10] The method of claim 9 wherein the styrenic resin is polystyrene.

- [c11] The method of claim 1 wherein the contact time is less than 8.0 ms.
- [c12] The method of claim 11 wherein the blowing agent is substantially 100% carbon dioxide.
- [c13] The method of claim 12 wherein the step of forming the extrudate includes mixing a nucleating agent into the extrudate prior to the extruding step.
- [c14] The method of claim 1 wherein the resultant foam has no visible corrugation.
- [c15] A method of extruding a polymeric foam from an extrudate comprising a polymeric resin and a blowing agent for providing the polymeric resin with a cellular structure upon exiting from an extruder having an annular die with an annular die opening and a choke ring having a choke ring opening formed by an annular choke ring surface and sized to receive at least a portion of the annular die, the extrusion die defining a longitudinal axis from which the annular die opening is spaced a first radial distance and the annular choke ring surface is spaced a second radial distance wherein the gap between the choke ring surface and the die is equal to the difference between the second radial distance and the first radial distance, the method comprising:
 - forming the extrudate by mixing a polymeric resin and a blowing agent consisting substantially of 100% carbon dioxide; and
 - extruding the extrudate through the choke ring gap so that the resultant extruded foam has an average cell size of 0.20 to 0.35 millimeter (mm).
- [c16] The method of claim 15 wherein the extruding step yields a foam having an average cell size of less than 0.30 mm.
- [c17] The method of claim 16 wherein the polymeric resin is polystyrene.
- [c18] The method of claim 15 wherein the extruding step includes pulling the extrudate through the die opening at a rate so that the extrudate contacts the choke ring surface within a contact time of 1.0 to 20.0 milliseconds (ms) after leaving the annular die opening.
- [c19] The method of claim 18 wherein the contact time is 1.0 to 8.0 ms.

[c20] The method of claim 15 wherein the extruding step yields a foam having an average cell size of less than 0.30 mm.

[c21] The method of claim 20 wherein the foam has no visible corrugation.

[c22] The method of claim 21 wherein the foam is substantially corrugation-free.

[c23] The method of claim 15 wherein the foam is in sheet form.

[c24] The method of claim 23 wherein the foam sheet has a thickness between 1.0 to 4.0 mm.

[c25] The method of claim 24 wherein the foam sheet has a density of 30 to 120 Kg/m³.

[c26] The method of claim 15 and further comprising the step of extruding the extrudate through the annular die opening so that the extrudate leaving the annular die opening contacts the annular choke ring surface within a contact time of 1.0 to 20.0 milliseconds.

[c27] The method of claim 26 wherein the foam has no visible corrugation.

[c28] The method of claim 26 wherein the contact time is 1.0 to 8.0 milliseconds.

[c29] The method of claim 15 wherein the foam has no visible corrugation.

[c30] The method of claim 15 and further comprising the step of constraining the extruded foam in contact with the choke ring for a constraint time of 5 to 75 milliseconds.

[c31] The method of claim 15 and further comprising the step of blending pentane with the carbon dioxide to form the blowing agent.

[c32] The method of claim 15 and further comprising the step of pulling the extrudate away from the die at a line speed of 50 millimeters per second to 250 millimeters per second.

[c33] The method of claim 15 and further comprising the step of mixing a nucleating agent into the extrudate prior to the extruding step.

[c34] A method of extruding a polymeric foam from an extrudate comprising a polymeric resin and a blowing agent for providing the polymeric resin with a cellular structure upon exiting from an extruder having an annular die with an annular die opening and a choke ring having a die aperture opening formed by an annular choke ring surface and sized to receive at least a portion of the annular die, the extrusion die defining a longitudinal axis from which the annular die opening is spaced a first radial distance and the annular choke ring surface is spaced a second radial distance wherein the gap between the choke ring and the die is equal to the difference between the second radial distance and the first radial distance, the method comprising:
forming the extrudate by mixing a polymeric resin and a blowing agent comprising a blowing agent blend; and
extruding the extrudate from the die opening and through the choke ring gap.

[c35] The method according to claim 34 and further comprising the step of selecting a choke ring gap of less than 4.6 mm.

[c36] The method according to claim 35 wherein the step of selecting the choke ring gap comprises selecting the choke ring gap less than 0.8 mm.

[c37] The method according to claim 34 wherein the extruding step further comprises pulling the extrudate from the die opening at a line speed so that the extrudate leaving the annular die opening contacts the annular choke ring surface within a contact time of 1.0 to 20.0 milliseconds.

[c38] The method of claim 37 and further comprising the step of constraining the extruded foam in contact with the choke ring for a constraint time of 5 to 75 milliseconds.

[c39] The method of claim 38 wherein the constraint time is 8 to 50 milliseconds.

[c40] The method of claim 34 wherein the extruding step includes extruding the extrudate through the choke ring gap such that the resultant foam has no visible corrugations.